1   <u>CLAIMS</u>

2

3   [001]   A method for controlling a brushless DC motor (1)

4   comprising the steps which are repeated cyclically: adjusting

5   a desired speed of the motor (1) by varying an average

6   terminal voltage of the motor; detecting the average power

7   requirement (P) of the motor (1) and the lead angle (θ)

8   between the rotor of the motor and the driving magnetic

9   field, approximating the lead angle (θ) to a desired value

10   given as a function of the speed (U) and the average power

11   requirement (P).

12

13   [002]   The method according to claim 1, characterised in that

14   the desired value is that value of the lead angle (θ) which

15   maximises the efficiency (η) of the motor (1) for the

16   allocated values of the speed and average power requirement.

17

18   [003]   The method according to claim 3, characterised in that

19   the desired value of the lead angle is determined from a

20   characteristic map (K) which specifies the lead angle with

21   the highest efficiency for a plurality of operating points of

22   the motor each defined by a speed and an average power

23   requirement.

24

25   [004]   The method according to claim 3, characterised in that

26   the desired value of the lead angle for the actual speed and

27   the average power requirement is obtained from the

28   characteristic map by interpolation.

29

30   [005]   The method according to any one of the preceding

31   claims, characterised in that in step a) the average terminal

32   power of the motor is varied by pulse width modulation.

33

1   [006]   A control device for a brushless DC motor (1)

2   comprising an AC/DC inverter (7) supplied by an intermediate

3   direct voltage circuit (+, -) for feeding the DC motor (1), a

4   pattern generator (3, 5, 6, 8-23) for controlling the

5   switches (SU1, SU2, SV1, SV2, SW1, SW2) of the AC/DC inverter

6   having a periodic switching signal pattern of variable

7   frequency and phase, which has an input for a representative

8   signal for an instantaneous phase position of the rotor of

9   the DC motor (1), characterised in that the pattern generator

10   has means (22, 21) for detecting the average current strength

11   delivered by the AC/DC inverter and means (3, 5, 8-23) for

12   adjusting a phase offset (lead angle) between the phase

13   position of the rotor and the switching signal pattern

14   depending on the detected average current strength and the

15   speed of the motor (1).

16

17   [007]   The control device according to claim 6, characterised

18   in that this has means (21-23) for regulating an average

19   terminal voltage of the motor (1) using a desired speed.

20

21   [008]   The control device according to claim 6 or claim 7,

22   characterised in that the means (3, 5, 8-23) for adjusting

23   the phase offset comprise a PLL circuit (3, 5, 8-20) which

24   can be locked to the frequency of the input signal

25   representative for the phase position of the rotor.

26

27   [009]   The control device according to claim 6, 7 or 8,

28   characterised in that the means (3, 5, 8-23) for adjusting

29   the phase offset comprise control means (21, 23) for

30   predefining a target phase offset depending on the detected

31   power and speed of the motor.

32

33   [010]   The control device according to claim 9, characterised

34   in that the control means (21, 23) comprise a storage device

1 (23) for the characteristic map of the motor (1), which

2 specifies for combinations of motor speed and power,

3 respectively one target phase offset which minimises the

4 power requirement of the motor (1).

5

6 [011] The control device according to any one of claims 6 to

7 10, characterised in that the means (3, 5, 8-23) for

8 adjusting the phase offset comprise means (21) for deriving

9 the speed from the input signal representative for the phase

10 position of the rotor.

11

12 [012] The control device according to any one of claims 6 to

13 11, characterised in that the means for adjusting the phase

14 offset comprise a desired value transmitter (21, 23) for

15 generating a representative signal for a desired value of the

16 phase offset and a regulator (3, 5, 8-20) for matching the

17 actual phase offset to the desired value using the

18 representative signal, wherein the representative signal can

19 have values above and below a representative value for a

20 phase offset of 0°.

21

1

2   <u>NEW CLAIMS</u>

3

4   1.   A method for controlling a brushless DC motor (1)

5   comprising the iteratively repeated steps for adjusting the

6   operating point of the motor (1) for a predetermined desired

7   speed: adjusting the speed of the motor (1) to the value of

8   the desired speed by varying an average terminal voltage of

9   the motor (1), wherein the average terminal voltage of the

10   motor (1) is determined by pulse width modulation; detecting

11   the average power requirement (P) of the motor (1) and the

12   lead angle (θ) between the rotor of the motor and the driving

13   magnetic field; approximating the lead angle (θ) to a

14   predetermined desired value as a function of the speed (U)

15   and the average power requirement (P).

16

17   2.   The method according to claim 1, characterised in that

18   the desired value is that value of the lead angle (θ) which

19   maximises the efficiency (η) of the motor (1) for the

20   allocated values of the speed and average power requirement.

21

22   3.   The method according to claim 3, characterised in that

23   the desired value of the lead angle is determined from a

24   characteristic map (K) which specifies the lead angle with

25   the highest efficiency for a plurality of operating points of

26   the motor each defined by a speed and an average power

27   requirement.

28

29   4.   The method according to claim 3, characterised in that

30   the desired value of the lead angle for the actual speed and

31   the average power requirement is obtained from the

32   characteristic map by interpolation.

33

1   5.   A control device for a brushless DC motor (1) comprising

2   an AC/DC inverter (7) supplied by an intermediate direct

3   voltage circuit (+, -) for feeding the DC motor (1), a

4   pattern generator (3, 5, 6, 8-23) for controlling the

5   switches (SU1, SU2, SV1, SV2, SW1, SW2) of the AC/DC inverter

6   having a periodic switching signal pattern of variable

7   frequency and phase, which has an input for a representative

8   signal for an instantaneous phase position of the rotor of

9   the DC motor (1), characterised in that the pattern generator

10   has means (22, 21) for detecting the average current strength

11   delivered by the AC/DC inverter and means (3, 5, 8-23) for

12   adjusting a lead angle between the phase position of the

13   rotor and the switching signal pattern depending on the

14   detected average current strength and the speed of the motor

15   (1), that the control device has means (21-23) for regulating

16   an average terminal voltage of the motor (1) using a desired

17   speed, and that the control device is designed to carry out

18   the method according to any one of claims 1 to 4.

19

20   6.   The control device according to claim 5, characterised in

21   that the means (3, 5, 8-23) for adjusting the lead angle

22   comprise a PLL circuit (3, 5, 8-20) which can be locked to

23   the frequency of the input signal representative for the

24   phase position of the rotor.

25

26   7.   The control device according to claim 5 or claim 6,

27   characterised in that the means (3, 5, 8-23) for adjusting

28   the lead angle comprise control means (21, 23) for

29   predefining a desired value of the lead angle depending on

30   the detected power and speed of the motor.

31

32   8.   The control device according to claim 7, characterised in

33   that the control means (21, 23) comprise a storage device

34   (23) for the characteristic map of the motor (1), which

1   specifies for combinations of motor speed and power,

2   respectively one desired value of the lead angle which

3   minimises the power requirement of the motor (1).

4

5   9.   The control device according to any one of claims 5 to 8,

6   characterised in that the means (3, 5, 8-23) for adjusting

7   the lead angle comprise means (21) for deriving the speed

8   from the input signal representative for the phase position

9   of the rotor.

10

11   10.   The control device according to any one of claims 5 to

12   9, characterised in that the means for adjusting the lead

13   angle comprise a desired value transmitter (21, 23) for

14   generating a representative signal for a desired value of the

15   lead angle and a regulator (3, 5, 8-20) for matching the

16   actual lead angle to the desired value using the

17   representative signal, wherein the representative signal can

18   have values above and below a representative value for a lead

19   angle of 0°.